MPCP – State of the Art

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MPCP = Converged Solution

- The Multi-Point Control Protocol (MPCP) specifies a control mechanism between a Master unit and Slaves units connected to a Point-to-Multi-Point (P2MP) segment to allow efficient transmission of data
- MPCP is implemented in MAC Control layer
- MPCP uses five MAC Control messages: `GATE`, `REPORT`, `REGISTER_REQ`, `REGISTER`, and `REGISTER_ACK`
- P2P Emulation is used for compliance with 802.1

MPCP Timing Model

- **Absolute timing model**
  - A global clock exists in the OLT
  - Absolute timestamps distribute clock
  - Timestamp added to all protocol related messages when generated
  - Clocks count in 16 bit-times resolution

RTT Compensation

- **Delay compensation is performed at OLT**
- **All grant start times are pre-compensated for RTT**
- **Example:**
  - If OLT is to receive data from an ONU at time *T*, it will send GATE with Slot Start = *T*-RTT
- **Saves complexities associated with distributed state when compared to alternative solutions**
- **Minimal and maximal distance defined between the timestamp and start-time, to allow for processing time**

Logical ONU Instance

- **Granting is per logical ONU instance**
  - The instance is addressed through a unique PHY ID using P2PE or SE layer
- **An ONU may have multiple logical instances at its physical location, allocated during the registration process**
- **A logical ONU instance can be easily mapped into a service flow, if required**

- **Multiple grants may be outstanding**
- **ONU is free to use granted period to it's best ability**

Message Structure

- MAC Control is layer responsible for message generation and termination
- Length limitation of 64 bytes imposed by MAC Control layer to be further studied
- MAC Control imposes known EtherType, demultiplexing is performed through opcode field
- Distinct opcode defined for each message type

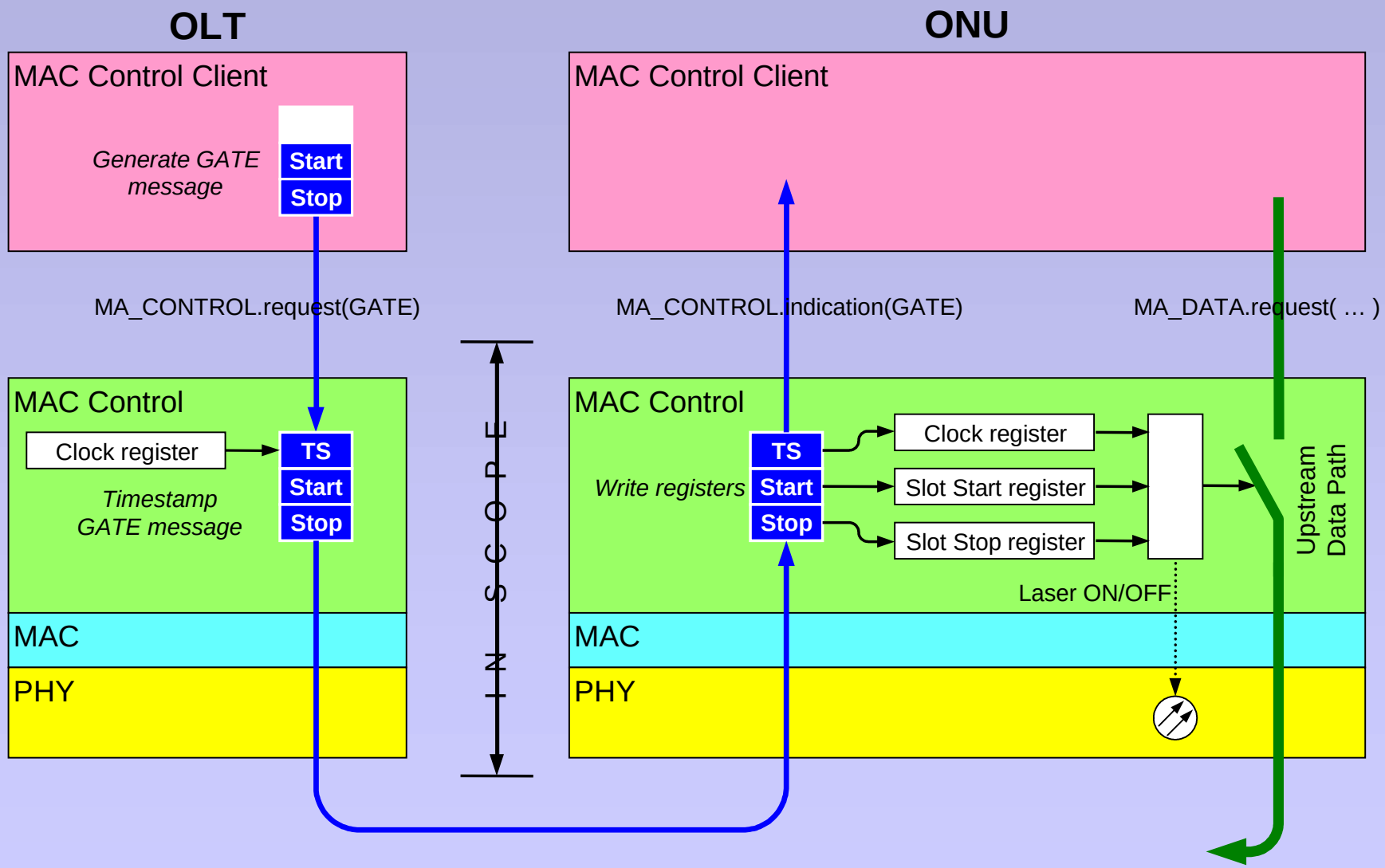
GATE Message

- **Fields**
  - 6 octets: Destination address
  - 6 octets: Source address
  - 2 octets: Type
  - 2 octets: Opcode
  - 4 octets: Timestamp
  - 1 octet: Number of grants
  - 4 octets: Slot start time
  - 2 octets: Slot length

  } Repeat * N

  - Optional fields
  - 4 octets: CRC

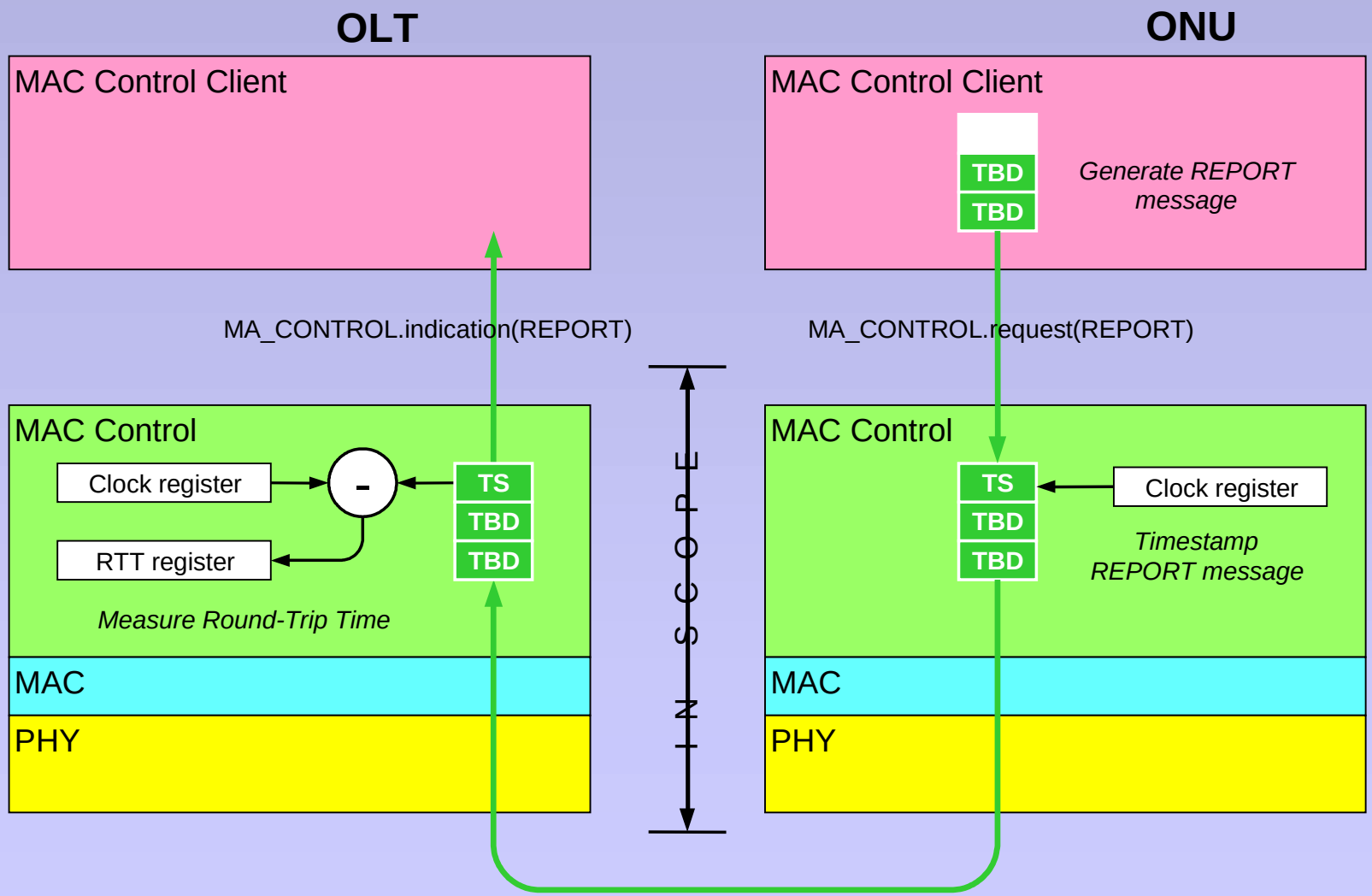
GATE Operation



REPORT Message

- **Fields**
  - 6 octets: Destination address
  - 6 octets: Source address
  - 2 octets: Type
  - 2 octets: Opcode
  - 4 octets: Timestamp
  - TBD
  - 4 octets: CRC

REP0RT Operation

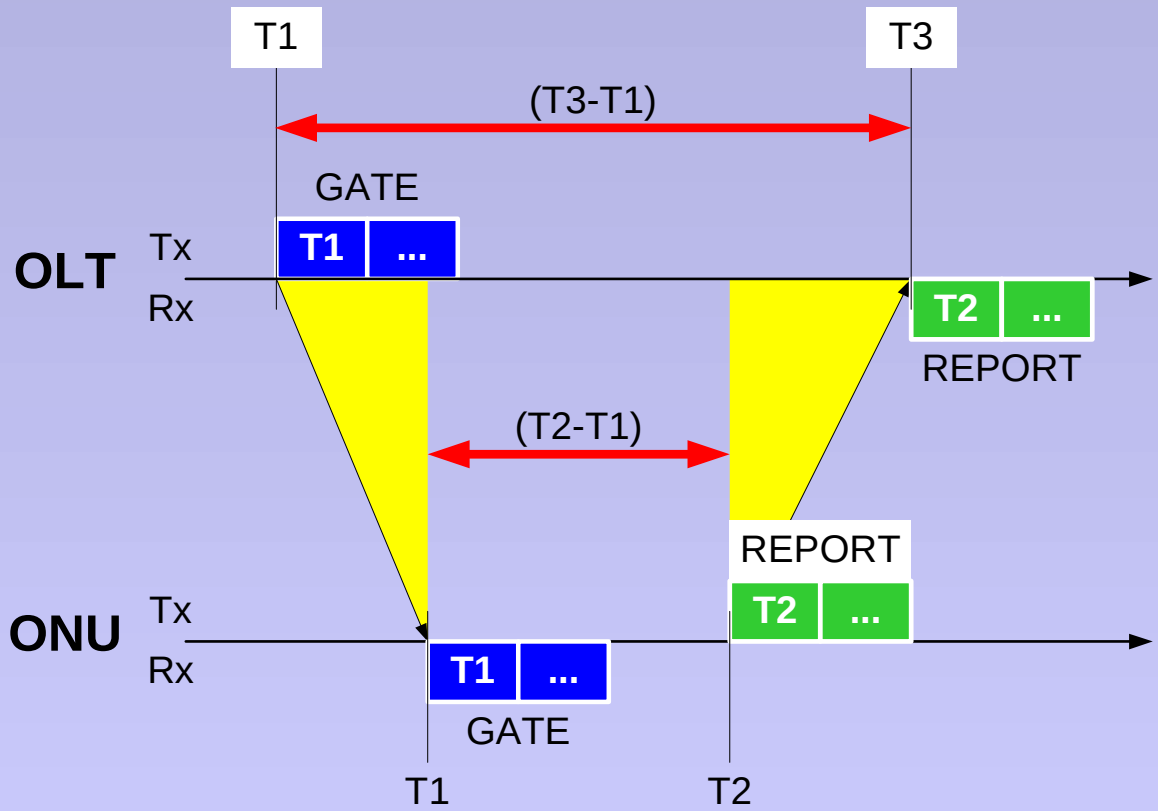


GATE/REPORT Behavior

- **Protocol layer conveys information**
  - OLT → ONU bandwidth assignemnt
  - ONU → OLT bandwidth request
- **Service layer sitting above makes decisions**
  - OLT bandwidth allocation
  - ONU bandwidth utilization
- **No obligation to generate GATE or REPORT messages imposed by protocol layer**

RTT Measurement

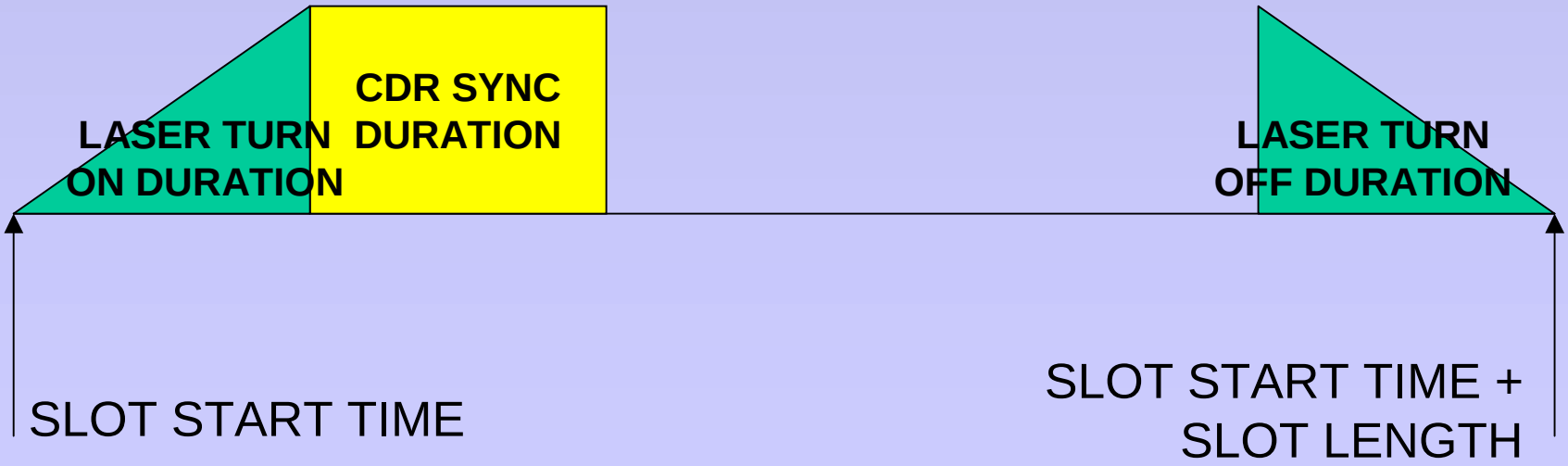
1. OLT sends GATE at T1
2. ONU receives GATE at T1
3. ONU sends REPORT at T2
4. OLT receives REPORT at T3
5. OLT calculates RTT = T3 – T2



RTT = (T3-T1) – (T2-T1) = T3-T2

Physical Layer Interfaces

- **Physical layer generates a preamble in the upstream to help the CDR lock**
- **OLT does not assume of ONU performance before initialization**
  - Slot start is laser on event
  - Slot end is laser off event



Decoupling of PMD Parameters

- **Three parameters isolated**
  - Laser on time
  - Laser off time
  - CDR lock time
- **Laser on/off parameters are local to ONU**
- **OLT propagates required CDR lock time during registration**
- **ONU requests pre-compensate for PMD overhead**

Summary

- MPCP is confined to one sub-layer – MAC Control
- MPCP allows higher layer to implement various DBA algorithms
- RTT compensation is performed
- Timing is embedded in control frames
- PMD parameters are plugable into model
- Multiple granted entities may exist in a single ONU using P2P emulation